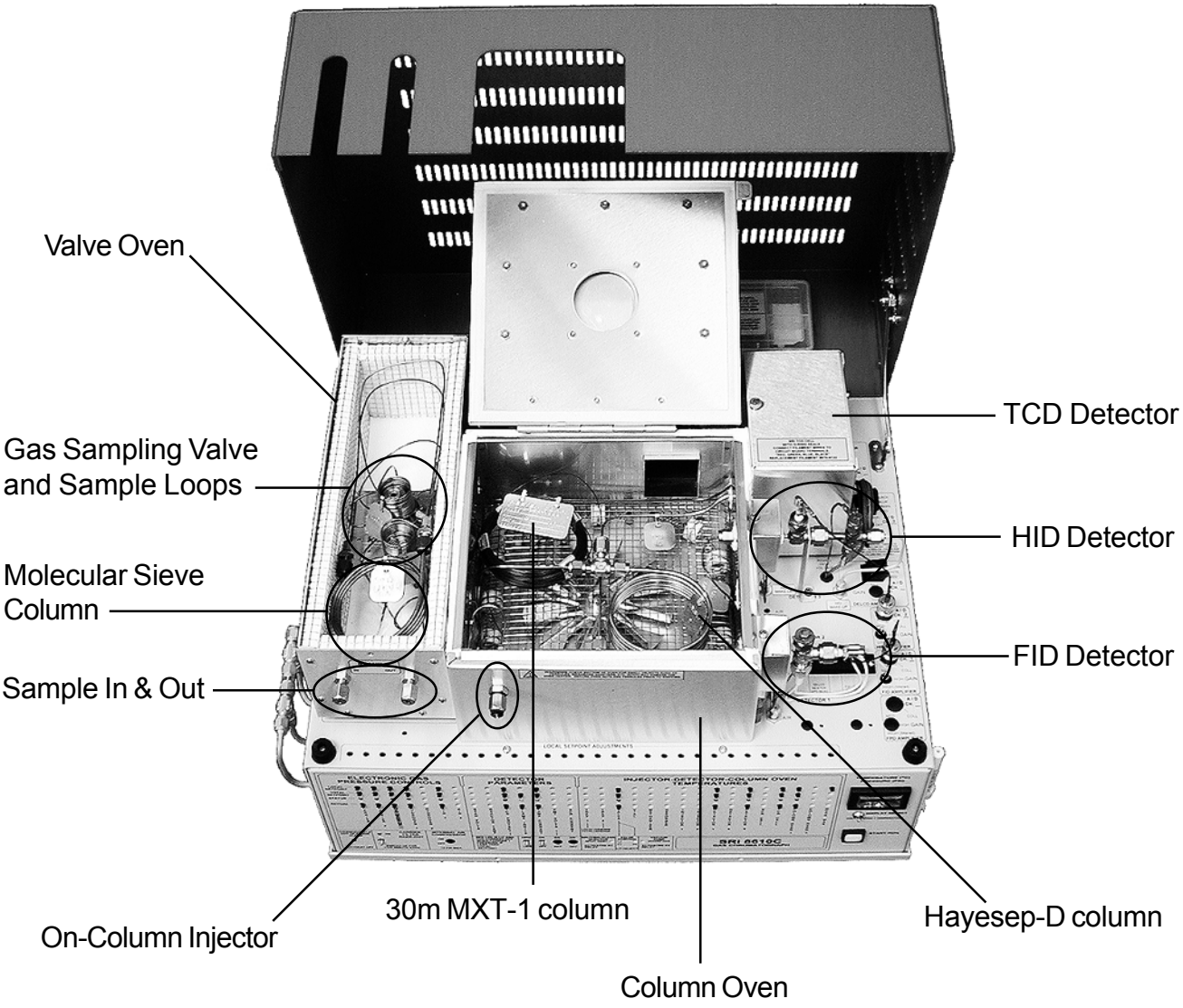
System Overview

The Multiple Gas Analyzer #2 is pre-plumbed and ready to resolve H_2, He, O_2, N_2, Methane, CO, Ethane, CO_2, Ethylene/Acetylene, NOx, Water, Alcohols, Propane, Butanes, Pentanes, and C_6 through C_{20}. Separation of this wide variety of peaks is accomplished using a 10 port automated Gas Sampling Valve with dual Sample Loops and two, three, or four columns. It can be optionally configured with **1)** a TCD, **2)** a TCD, Methanizer, FID, or **3)** with TCD, HID and FID detectors. All three versions have a 1m (3') Molecular Sieve packed column in the Valve Oven, and a 2m (6') Hayesep-D packed column in the Column Oven. The model shown below is customized with TCD, HID and FID detectors. In addition to the Hayesep-D column, it has an optional 30m MXT-1 capillary column in the Column Oven.

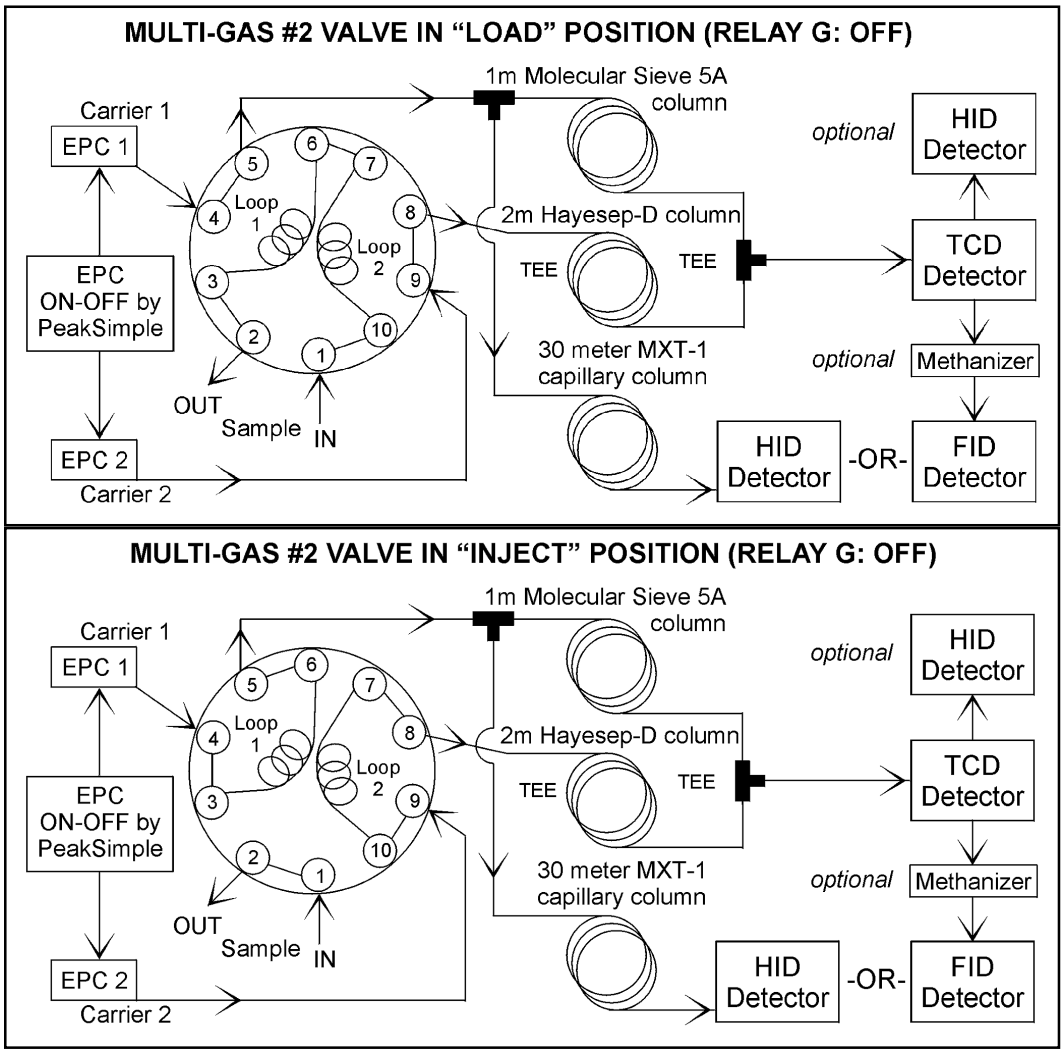


POPULAR CONFIGURATION GCs
Multiple Gas Analyzer #2

Theory of Operation

The Multiple Gas Analyzer #2 GC uses a single automated 10 port Gas Sampling Valve and multiple columns to separate a wide variety of peaks. The system achieves this by turning the carrier gas flow to each column on at different times during the run. This procedure allows the Molecular Sieve column in the Valve Oven to completely separate H_2, He, O_2, N_2, CH_4 and CO before the carrier flow to the Hayesep-D column in the Column Oven is turned on. The Hayesep-D column then separates all compounds in the C_1-C_6 range. An optional 30m MXT-1 capillary column in the Column Oven separates the remaining hydrocarbons out through C_{20}, using the same carrier gas flow as the Hayesep-D column and an FID or HID detector.

This configuration uses two carrier gas flows, each regulated by Electronic Pressure Control (EPC) using the PeakSimple data system. Carrier 1 flows to the Molecular Sieve column, then on through the "Tee" to the TCD detector, and it is always on; if not, the lack of carrier gas flow triggers the TCD filament protection circuit. Carrier 2 flows to another "Tee" where it splits to enter the Hayesep-D column and also the MXT-1 column. The flow from the Hayesep-D column continues to the TCD detector, and the flow from the MXT-1 goes to the FID or HID detector. The carrier #2 flow (EPC 2) is turned on and off by PeakSimple, controlled by the user.



When the 10 port Gas Sampling Valve is in LOAD position, the two carrier gas flows bypass the Sample Loops through the Valve and travel on to the columns.

When the 10 port Gas Sampling Valve is in INJECT position, the two carrier gas flows sweep through the Sample Loops, sending their contents to the columns and detectors.

General Operating Procedure

1. Set the gas cylinder pressure 15-20psi higher than the head pressure (helium carrier). The carrier head pressure used to generate the test chromatograms at the factory is printed on the right side of your GC. Typical head pressure for a Multi-Gas instrument operating at 20mL/min is about 20psi.

2. Damage or destruction of the TCD filaments will occur if current is applied in the absence of flowing carrier gas. ALWAYS verify that carrier gas can be detected exiting the TCD carrier gas outlet BEFORE energizing the TCD. Labelled for identification, the carrier gas outlet is located inside the Column Oven. Place the end of the tube in liquid and observe (a bit of spit on a finger can suffice). If there are no bubbles exiting the tube, there is a flow problem. DO NOT turn on the TCD current if carrier gas flow is not detectable. A filament protection circuit prevents filament damage if carrier gas pressure is not detected at the GC, but it cannot prevent filament damage under all circumstances. Any lack of carrier gas flow should be corrected before proceeding.

3. Set the Valve Oven temperature to 90°C. (The Molecular Sieve column is in the Valve Oven.)

4. Turn the TCD current to LOW. Ignite FID if present. Turn Methanizer to 380°C if present. Turn HID current on if present.

5. Set the Column Oven temperature program as follows:

Initial Temp	Hold	Ramp	Final Temp
50°C	7.00	10.00	220°C
220°C	10.00	0.00	220°C

6. Type in an event table as follows:

Time	Event
0.000	ZERO (auto zero data system signal at start of run)
0.050	G ON (valve inject)
0.100	B ON (carrier #2 flow OFF)
7.500	B OFF (carrier #2 flow ON)

EPC #2 controls the carrier #2 flow. When the limiter (B) is turned ON, this flow is shut off. The event table should allow for the elution of CO from the Molecular Sieve column before the limiter (B) is turned OFF and carrier #2 flow restored. The Valve Oven temperature may be increased to speed the elution of the H_2, O_2, N_2, CH_4, and CO.

7. Load your sample gas stream by connecting the flow to the sample inlet port on the front of the Valve Oven.

8. Start the analysis by pressing the RUN button on the front of your GC, or by pressing your PC keyboard's spacebar.

POPULAR CONFIGURATION GCs
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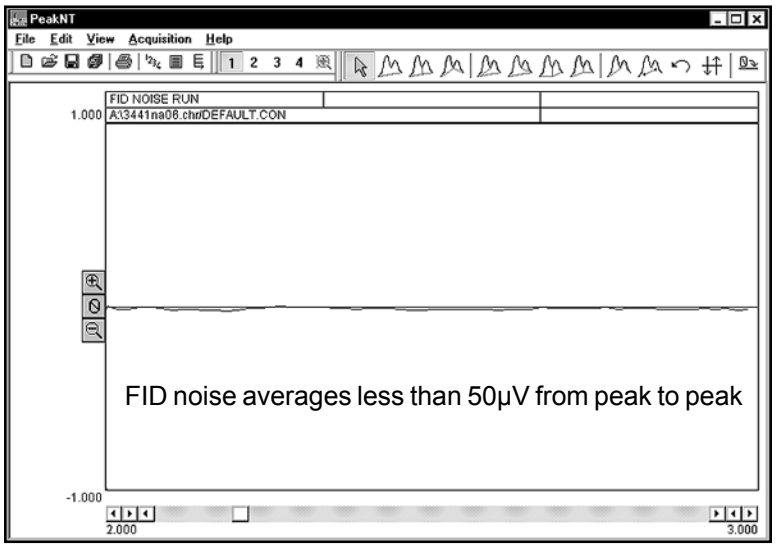
Expected Performance



FID noise run

Columns: 1m Mol. Sieve, 2m Hayesep-D,
30m MXT-1
Carrier: Helium @ 10mL/min
FID gain = HIGH
FID temp = 150°C
FID ignitor = -400
Valve temp = 110°C

Temperature Program:

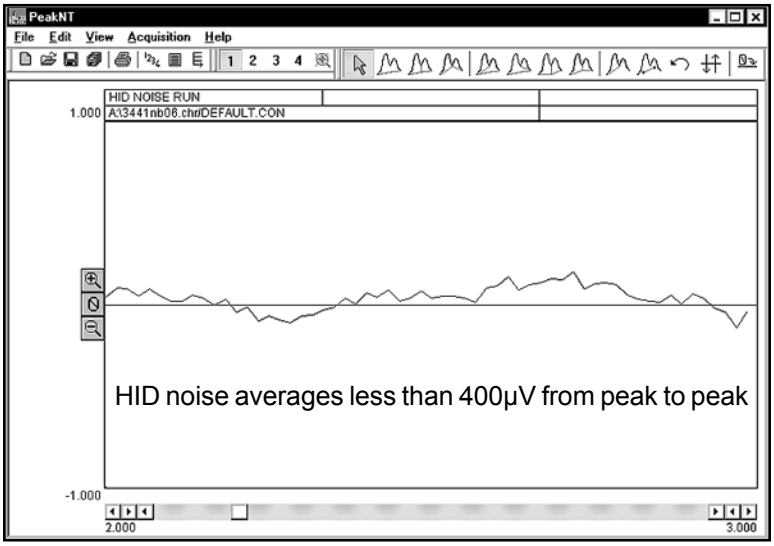
Initial	Hold	Ramp	Final
80°C	15.00	0.00	80°C

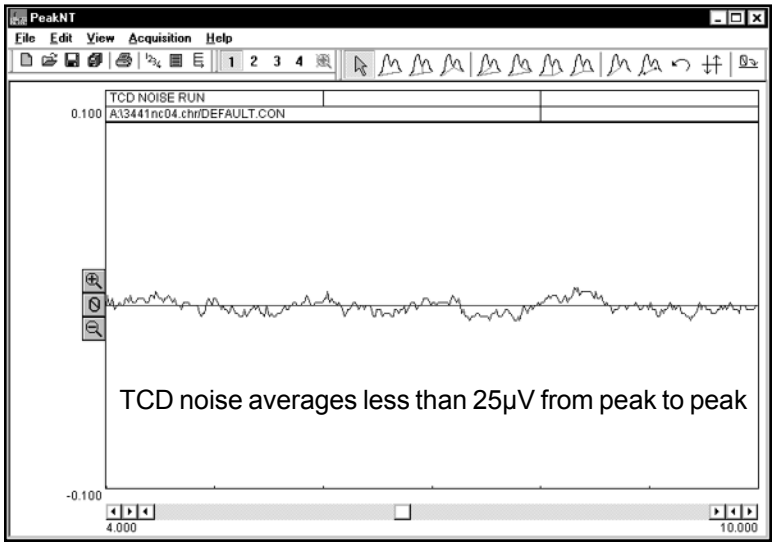
HID noise run

Columns: 1m Mol. Sieve, 2m Hayesep-D,
30m MXT-1
Carrier: Helium @ 10mL/min
HID gain = HIGH
HID current = 70
HID temp = 200°C
Valve temp = 110°C

Temperature Program:

Initial	Hold	Ramp	Final
80°C	15.00	0.00	80°C





TCD noise run

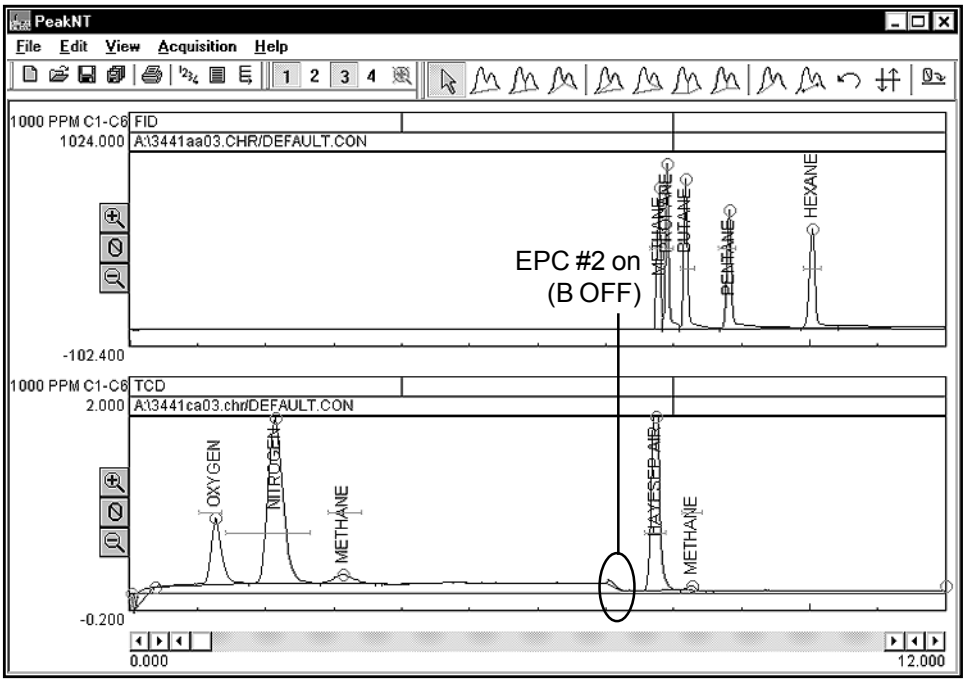
Columns: 1m Mol. Sieve, 2m Hayesep-D,
30m MXT-1
Carrier: Helium @ 10mL/min
TCD gain = LOW
TCD temp = 100°C
Valve temp = 110°C

Temperature Program:

Initial	Hold	Ramp	Final
80°C	15.00	0.00	80°C

Expected Performance: FID & TCD Detectors

These two factory test runs utilized the same carrier flow and temperature program. The first chromatogram resulted from a run with a 1000ppm C_1-C_6 sample; the second, a 1% fixed gas standard sample.



Test Run #1

Sample: 1000ppm C_1-C_6

Events:

Time	Event
0.050	G ON (valve inject)
0.100	B ON (carrier #2 flow off)
0.400	G OFF
7.000	B OFF (carrier #2 flow on)

FID Results:

Component	Retention	Area
Methane	7.733	838.3160
Ethane	7.783	2066.2065
Propane	7.883	2953.3865
Butane	8.166	3479.4540
Pentane	8.800	4021.5110
Hexane	10.016	3512.6800
	Total	16871.5540

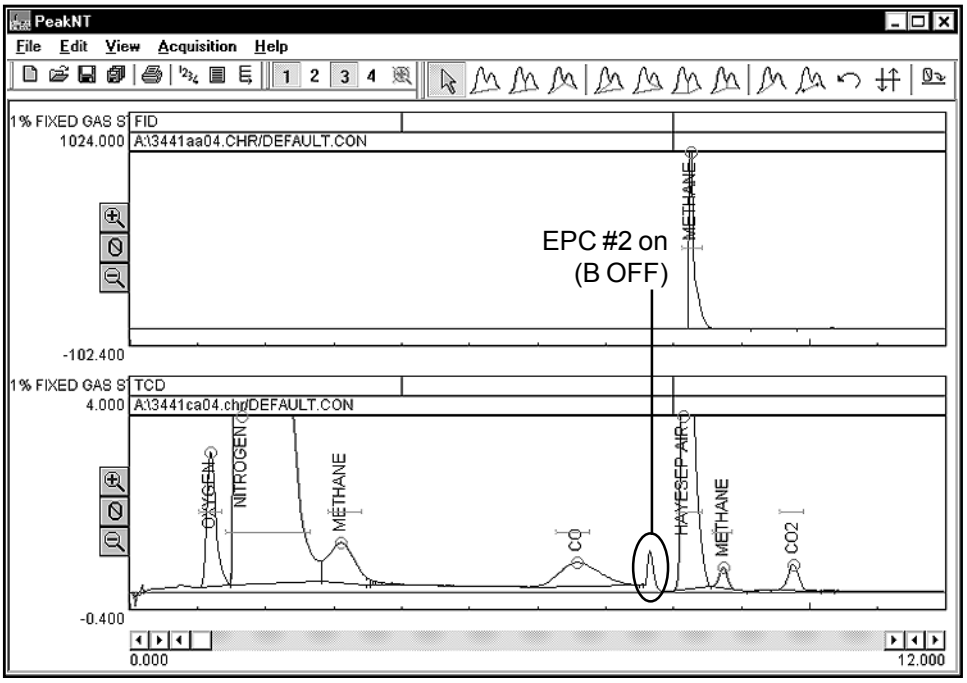
TCD Results:

Component	Retention	Area
Oxygen	1.250	7.9800
Nitrogen	2.116	27.9765
Methane	3.116	2.0210
Hayesep Air	7.716	23.5150
Methane	8.250	0.4950
Ethane	12.133	1.0240
	Total	63.0115

Columns: 1m Mol. Sieve,
2m Hayesep-D,
30m MXT-1
Carrier: Helium @ 10mL/min through each column

Temperature Program:

Initial	Hold	Ramp	Final
50°C	7.00	10.00	220°C
220°C	10.00	0.00	220°C



Test Run #2

Sample: 1% fixed gas standard

Events:

Time	Event
0.050	G ON (valve inject)
0.100	B ON (carrier #2 flow off)
0.400	G OFF
7.500	B OFF (carrier #2 flow on)

FID Results:

Component	Retention	Area
Methane	8.233	12144.3770

TCD Results:

Component	Retention	Area
Oxygen	1.166	26.4920
Nitrogen	1.633	2251.7140
Methane	3.083	23.0975
CO	6.566	22.2440
Hayesep Air	8.116	524.2010
Methane	8.716	3.7730
CO2	9.750	6.3940
	Total	63.0115

POPULAR CONFIGURATION GCs
Multiple Gas Analyzer #2

Expected Performance: HID & TCD Detectors

These two factory test runs utilized the same carrier flow, temperature program, and event table. The first chromatogram resulted from a run with a 1000ppm C_1-C_6 sample; the second, a 1% fixed gas standard sample.

Test Run #1

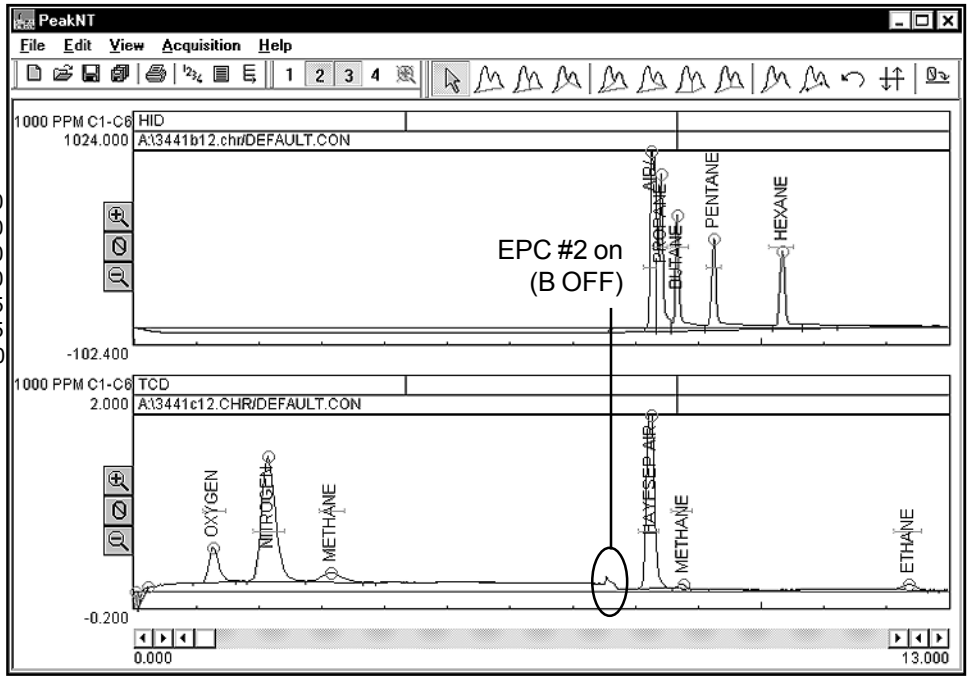
Sample: 1000ppm C_1-C_6

HID Results:

Component	Retention	Area
Air/Methane	8.233	6249.3320
Ethane	8.283	3064.2580
Propane	8.383	3408.5720
Butane	8.650	2265.3520
Pentane	9.216	2650.8955
Hexane	10.316	2260.8975
	Total	19899.3070

TCD Results:

Component	Retention	Area
Oxygen	1.250	4.0220
Nitrogen	2.116	21.0510
Methane	3.116	2.1900
Hayesep Air	8.216	22.4900
Methane	8.733	0.4460
Ethane	12.333	0.9640
	Total	51.1630



Columns: 1m Mol. Sieve,
2m Hayesep-D,
30m MXT-1
Carrier: Helium @ 10mL/min through each column

Temperature Program:

Initial	Hold	Ramp	Final
50°C	7.00	10.00	220°C
220°C	10.00	0.00	220°C

Events:

Time	Event
0.050	G ON (valve inject)
0.100	B ON (carrier #2 flow off)
0.400	G OFF
7.500	B OFF (carrier #2 flow on)

Test Run #2

Sample: 1% fixed gas standard

FID Results:

Component	Retention	Area
Methane	8.266	44548.0540

TCD Results:

Component	Retention	Area
Oxygen	1.166	31.0260
Nitrogen	1.616	2261.6430
Methane	3.050	12.6240
CO	6.400	22.4410
Hayesep Air	8.116	542.6790
Methane	8.716	3.5950
CO2	9.750	6.6920
	Total	2880.7000